

**EXERCISE RESISTANCE****CROSS-REFERENCE TO RELATED APPLICATIONS**

None.

**5 STATEMENT REGARDING FEDERALLY SPONSORED  
RESEARCH OR DEVELOPMENT**

Not Applicable.

**BACKGROUND OF THE INVENTION**

This invention relates to exercise equipment and more particularly to exercise  
10 equipment which can provide a changing workload.

It is known that, for maximum benefit, an athlete in training must push himself to his  
maximum strength limits. This is difficult to achieve with conventional weight training  
equipment such as a bench press machine or other general purpose or special purpose  
machines since generally the athlete has heretofore stopped exercising when he reaches his  
15 first point of momentary muscular failure (MMF). At that point, the athlete must either  
personally change the weight on the machine he is using, or a second person must change the  
weight for him so that the athlete can continue using the machine. This either unnecessarily  
interrupts the exercise, or requires the continual presence of a second, non-exercising partner.  
If the athlete were able to experience multiple MMF's during any one set of a specific  
20 exercise, he would eventually reach his absolute fatigue point (AFP). However, with  
conventional exercise equipment, the AFP is extremely difficult or impossible to reach due to  
the drawbacks described above.

Consider the case of an athlete lifting 120 pounds while doing bench presses. In this  
exercise, direct resistance is placed upon pectoral major and anterior deltoids. Soon, for

example after only ten complete repetitions, this athlete is no longer able to complete another repetition. As a direct result, he stops exercising, even though he would be able to continue exercising at a lower weight amount, and ultimately reach his AFP. (AFP is the point in which no movement can occur even where the weight amount is as little as 10 per cent of what the athlete began with). At this point the athlete has reached only one MMF point. It is known that a muscle will recover up to 50 per cent of its strength in three seconds. This means that if the athlete was bench pressing 120 pounds ten times, after three seconds of rest he should be able to do up to six more repetitions, thus reaching multiple MMF's which is critical to hypertrophy. As is known, the central key to working out and obtaining results, is to push the muscle beyond its normal everyday demands.

Many of these issues have been addressed in co-assigned U.S. Patents 5,350,344 and 4,746,113. However, it has been discovered that conventional weight stacks are not optimally suited to systems that automatically change the weight resistance upon occurrence of conditions such as MMF.

For example, conventional weight stacks include a number of identical weight plates (optionally with some smaller weights of a second value that can be manually connected to the weight stack). Changing the weight resistance automatically in such a system can be complicated and expensive. For example, one possible approach is to provide individual automatically actuatable selector pins for each plate that can be chosen as needed to choose the desired weight for the stack at that point in the exercise. Alternatively, a movable pin or pins can travel along the weight stack to the desired position for selecting the proper resistance. The first alternative is costly and complicated, while the second is merely complicated. Both could be improved.

## SUMMARY OF THE INVENTION

Among the various objects and features of the present invention may be noted that the provision of a resistance system for an exercise machine which facilitates the changing of weight resistance in response to conditions such as MMF.

5        Another object of the present invention is a provision of such a system which is readily adaptable to conventional exercise equipment already in the field.

A third object of the present invention is the provision of such a system which is economical and reliable.

Other objects and features of the present invention will be in part apparent and in part  
10    pointed out here and after.

Briefly, in a first aspect of the invention a resistance system for an exercise machine includes a plurality of resistance providing members having at least three different values of resistance and a selector for selecting sets of resistance providing members from the plurality of resistance providing members. The values of the resistances for a selected set determine  
15    the total resistance of the resistance system when the selected set is selected.

In a second aspect of the present invention, a resistance system for an exercise machine includes a plurality of resistance providing members disposed horizontally with respect to each other. A selector selects sets of resistance providing members from the plurality of resistance providing members, the values of the resistances for a selected set  
20    determining the total resistance of the resistance system when said selected set is selected. A controller automatically controls the selector to change the total resistance of the resistance system upon occurrence of a predetermined condition, such as MMF.

In a third aspect of the present invention, a resistance system provides a controllable resistance for an exercise device or machine. The system includes a plurality of selectable

weights, each of the plurality of weights being selectable to be included in the controllable resistance. A selector is disposed adjacent each of the selectable weights, the selector including a plurality of actuators corresponding to each selectable weight such that when one of the actuators is actuated the corresponding selectable weight is included in the controllable resistance.

In a fourth aspect of the present invention, an exercise machine includes a plurality of resistance providing members having at least three different values of resistance, and a selector for selecting sets of resistance providing members from the plurality of resistance providing members. The values of the resistances for a selected set determine the total resistance of the resistance system when the selected set is selected. A manually operable member such as a bar is adapted to be moved by a user, and is operatively linked to the selected set of resistance providing members so that movement of the manually operable member by the user must overcome the resistance provided by the selected set of resistance providing members.

In a fifth aspect of the present invention a method of retrofitting an exercise machine having a weight stack includes the steps of removing the existing weight stack of the exercise machine, replacing the existing weight stack with a set of weights having at least three different values of resistance, and providing a selector adapted to select various combinations of the weights in said set of weights.

In a sixth aspect of the present invention a method of changing resistance in an exercise device includes the steps of moving a selector to a predetermined position, disengaging a first set of weights while the selector is at the predetermined position, and engaging a second set of weights while the selector is at the predetermined position, wherein

the second set of weights including individual weights of at least three different values of resistance.

## **BRIEF DESCRIPTION OF THE DRAWINGS**

FIG. 1 is a front elevation of an exercise resistance system of the present invention;

5        FIG. 1A is a perspective view of an illustrative exercise machine using the exercise resistance system of the present invention;

FIG. 2 is an exploded perspective view of the selector/lift mechanism of the exercise resistance system of Fig. 1;

10        FIG. 3 is a front elevation of an alternative embodiment of the exercise resistance system of the present invention;

FIG. 4 is a simplified top view of an alternative weight stack of the present invention;

FIG. 4A is a top view of a selector used with the weight stack of Fig. 4;

FIG. 5 is a top view of the present invention being used with a barbell on a weight bench; and

15        FIG. 6 is a cross-sectional view showing a portion of an optional base for the weight stack of the present invention.

Similar reference characters indicate similar parts throughout the several views of the drawings.

## **DESCRIPTION OF THE PREFERRED EMBODIMENT**

20        Turning to Fig. 1, a resistance system 11 of the present invention is designed for use in connection with any conventional exercise machine 13 (only a portion of the conventional exercise machine is shown). It should be understood that the present invention is not limited to any particular type of exercise machine, but rather is applicable to all and is intended to be so used. For example, Fig. 1A shows a conventional exercise machine 1 having a manually

operable members 2 that the user using to exercise against resistance. The particular machine 1 shown has a cowling 3 with a readout 4 covering the weight stack (described below). Preferably, a sensor 5 is disposed either in the lower or upper portion of the cowling on the exercise machine to sense the condition (speed, force, etc.) of the exercise to determine when a change in resistance would be beneficial. Although an exercise machine in the conventional sense is shown, it should be understood that the present invention may also be used with much simpler machines (sometimes called devices) such as a barbell. That is, the changeable resistance of the present invention may be used to change the resistance of a barbell, or the resistance of more complicated exercise machines.

Resistance system 11 includes a plurality of resistance providing members 15 having at least three different values of resistance. For example, in Fig. 1, resistance providing members 15 are 4, 8, 16, 32 and 64 pound weights labeled 19, 21, 23, 25, and 27 respectively. As shown, there are dual, symmetrically disposed weights of each weight value (except the middle weight 19) for balance purposes. It should be appreciated that the dual construction is desirable but not necessary to the present invention.

More importantly, it should be noted that the weights 15 are disposed horizontally with respect to each other, so that individual weights can be selected independently of whether any other weight is selected. This feature provides enormous flexibility of the present invention over the conventional weight stack. Note as well the use of different weight values that are integral multiples of the smallest weight (in this example, a four pound weight). This use of different weight values in this fashion provides a great number of total weight combinations using a minimal number of actual weights. That is, the values of the resistances for a selected set determine the total resistance of the resistance system when that selected set is selected.

It should be understood that other means may be used as resistance providing members 15, such as elastic cords, shocks, electromagnetic resistance devices, springs, and the like.

Immediately above resistance providing members 15, a selector 31 is disposed for  
5 selecting sets of resistance providing members from the plurality of resistance providing members. As can be seen in Fig. 2, selector 31 includes a lift plate 33 and a plurality of actuators 35 disposed horizontally with respect to each other in suitable recesses 37 in plate 33.

In practice, each weight resistance member 15 (or each pair) would have an actuator  
10 35 associated therewith so that particular weight (or weight pair) could be selected. In Fig. 2, the number of actuators (and recesses) shown is reduced for purposes of clarity. Plate 33 also includes openings 41 for receiving the guide rods 43 of the conventional exercise machine. (It should be understood that not all exercise machines have guide rods—the guide rods are shown only for purposes of illustration). Although selector 31 is shown in Fig. 2 as including  
15 a plate, the shape of the member holding the actuators may be varied as desired.

Turning back to Fig. 1, selector 31 is disposed above resistance providing members 15 in an exercise machine frame 45 and is attached to a conventional lifting cable or belt 47 whose other end is connected to the user operated portion of the exercise machine (not shown). The selector (and any selected weights) moves vertically within the exercise  
20 machine frame 45 in response to the user exerting force on the lifting cable 47.

The present system also includes a controller 51 (shown in Fig. 1 as being mounted to the exercise machine frame 45) connected to selector 31 by a cable 53 and to a suitable sensor or sensors 55. It should be understood that the controller may be placed wherever is

most convenient. The controller may be any suitable computer or circuitry. The particular computer or circuitry is a matter of choice since nothing about the controller itself is unique.

Controller 51 controls the actuation of the various actuators 35 in selector 31 in response to the detection of a condition such as MMF by sensor(s) 55. For example, assume  
5 that the outermost weights are connected to move with the lift plate 33 by the suitable actuators. Assume as well that the weight of the lift plate is sixteen pounds, so that the total weight being lifted at that point is eighty pounds.

When sensor(s) 55 receive signals indicative of MMF, the controller 51 identifies that condition and, when the lift plate returns to the position shown in Fig. 1, activates (through  
10 cable 53) the actuators associated with all three of the four pound weights 19, both of the eight pound weights 21, and both of the sixteen pound weights 23, for a total weight (with the lift plate) of seventy-six pounds. It also deactivates the actuators associated with the thirty-two pound weights 25, so that upon the next repetition of the exercise the total weight has been reduced. (Of course, the amount of change in the total weight may differ from the  
15 smallest increment as desired or needed by the particular user or the particular exercise.) And, although the operation has been described in connection with MMF, any other condition may also be used as the triggering event.

Turning to Fig. 3, an alternative embodiment of the resistance system of the present invention is shown. In this embodiment, the lift member is a cylinder 61, mounted on an axle  
20 63. Movement of lift belt 47 causes the cylinder to rotate about its axis, raising and lowering any attached weights.

In this particular embodiment, the weights are not arranged in pairs, as in the previous embodiment (although whether the weights are arranged in pairs or not does not constitute a part of the broadest invention with either embodiment). Single weights 65, 67, 69, 71, 73,



and 75 (having weights of four pounds, eight pounds, sixteen pounds, thirty-two pounds, sixty-four pounds, and 128 pounds respectively) are connected by straps 77 to lift cylinder or drum 62. Actuators 35 (not shown) are mounted inside drum 62, so that under control of controller 51 (also not shown in Fig. 3) any combination of the weights may be attached to or  
5 detached from the drum. As the drum rotates (as a result of force applied to lifting belt 47, the actuated weights are lifted and lowered. Upon the occurrence of a condition such as MMF, the controller changes the weight by suitable control of the actuators.

Turning to Figs. 4 and 4A, it can be seen that the present invention may be used with a large variety of arrangements and placements of weights. For example, Fig. 4 shows a set  
10 of thirteen weights 81-93. Each weight includes a projection (not shown) for accepting the rod of its corresponding actuator to select the weight (as is described below). The weights extend vertically, and are all substantially the same height so that each individually and collectively can be selected by the selector. The weights preferably sit in an open-faced base (discussed below in connection with Fig. 6) which holds the weights in their rest positions.  
15 By way of example, weights 81, 87 and 93 are four pound weights, weight 82 and 92 are thirty-two pound weights, weights 83 and 91 are eight pound weights, weights 84 and 90 are sixteen pound weights, weight 85 is a two pound weight, weights 86 and 88 are sixty-four pound weights, and weight 89 is a one pound weight.

The projections of each weight, when the selector 94 is in its home position  
20 immediately over the weights, extend between corresponding actuators and tangs of the selector. For example, the actuator of weight 81 is actuator 81A and the corresponding tang is 81T. When the selector is in the home position, the controller 51 may change the weight from fifty pounds to forty pounds by, for example, disengaging actuators 82A, 84A, and 85A

(thereby releasing weights 82, 84 and 85) and engaging actuators 91A and 92A. Of course various other combinations of weights could be used as well.

The present invention is particularly suitable for use in a retrofit kit for an existing exercise machine, but it may also be used to create totally new exercise machines. For example, in Fig. 5, a barbell using the weight resistance system of the present invention is illustrated. Of course, the invention is also applicable to any other type free weight machine. The bar 101 of the barbell is shown connected to a two-part selector 103 disposed above a set of weights on each side. The weights of each set are, for example, five pounds, ten pounds, twenty pounds, forty pounds, and eighty pounds. When the bar is lowered to the home position, at which the selector is immediately over the weights, the weight resistance may be changed in the same manner as described above. That is, each weight has (in the selector) an actuator and tang associated therewith, so that weights are selected (added to the weight of the barbell) by actuating the corresponding actuator while the selector is at the home position and other weights (as desired) are unselected (removed from the weight of the barbell) by deactuating the corresponding actuator. Barbell 101 with selector 103 may be used with a weight training bench 105 as shown, or in any other conventional manner. If desired, a foot pedal 107 may be included to provide a signal to the selector 103 to change the weight.

Turning to Fig. 6, in one embodiment of the invention, the weights rest in a base 111. The weights in this embodiment are tapered at their lower ends as shown in Fig. 6, and the base 111 includes correspondingly tapered openings 113 sized to accept the corresponding weights. That is, there is an opening for each weight, and each opening is sized to accept its corresponding weight. The tapered openings 113 ensure that as a weight is lowered to the rest position, it is guided into the corresponding opening. This ensures that the weights are always in the desired position for selection/deselection. It should be understood that the

amount of taper shown in Fig. 6 can be varied as desired. In Fig. 6, one weight 86 is shown in the rest position in the base, while weights 81 and 89 are shown being lowered into their openings 113.

It should be understood that the present invention may be embodied in a variety of ways, since the invention itself provides great design flexibility.

In view of the above, it will be seen that the various objects and features of this invention are achieved and other advantageous results obtained. As various changes could be made in the above constructions and methods without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.